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(Continued from page 701)

$$x = \frac{\log (5/3)}{\log 4},$$

and the student is assured by the instructor, but rarely by the author of the text, that the two answers are the same. We can show that if a, b, c, and d are positive real numbers, $c \neq 1$ and $d \neq 1$, then

$$\frac{\log_c a}{\log_c b} = \frac{\log_d a}{\log_d b}.$$

The justification is based on the change-of-base formula found in most algebra texts (for example, *College Algebra* by W. Heming and D. Varberg [Englewood Cliffs, N.J.: Prentice-Hall, 1980, p. 239]). It asserts that if a, c, and d are positive real numbers and $c \neq 1$ and $d \neq 1$, then

$$\log_d c \log_c a = \log_d a.$$

Thus

$$\frac{\log_c a}{\log_c b} = \frac{\log_d c \log_c a}{\log_d c \log_c b} = \frac{\log_d a}{\log_d b}.$$

The change-of-base formula, and other properties of logarithms, can be used to establish a large number of logarithmic identities. Not all these identities are as practical as the one in the theorem, but establishing these identifies can give algebra students needed practice in handling theoretical properties of logarithms.

In the following list of identities, it is assumed that all bases are positive numbers not equal to 1 and that only logarithms of positive numbers are involved.

1. $\log_b m \log_m b = 1$
2. $\log_b m = 1/\log_m b$
3. $\log_a b = \ln b/\ln a$
4. $\log_{a^b} m = (1/b)\log_a m$
5. $\log_{a^b} m = 1/(b \log_m a)$

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Tribonacci formula

Readers who enjoyed the Fibonacci formulas presented by Lucille Kelly (November 1982) in "A Generalization of the Fibonacci Formulae" may also find the following formula concerning the "tribonacci" sequence to be of interest.

Let the sequence be defined by the following: $T_1 = 0$, $T_2 = 0$, $T_3 = 1$, and $T_n = T_{n-3} + T_{n-2} + T_{n-1}$ for $n \geq 4$. Writing out a few terms of the sequence yields 0, 0, 1, 1, 2, 4, 7, 13, 24, ...

A formula for the sum of the first n terms of the sequence is

$$\sum_{i=1}^{n} T_i = \tfrac{1}{2}(T_n + T_{n+2} - 1).$$

Example:

$$\sum_{i=1}^{7} T_i = \tfrac{1}{2}(7 + 24 - 1) = \tfrac{1}{2}(30) = 15$$

The formula can be proved using mathematical induction. The formula holds for $n = 1$. Assuming that the formula holds for $n = k$, it can be shown that it holds for $n = k + 1$:

$$\begin{aligned} &\sum_{i=1}^{k+1} T_i \\ &= \sum_{i=1}^{k} T_i + T_{k+1} \\ &= \tfrac{1}{2}(T_k + T_{k+2} - 1) + \frac{2T_k + 1}{2} \\ &= \tfrac{1}{2}[T_{k+1} + (T_k + T_{k+1} + T_{k+2}) - 1] \\ &= \tfrac{1}{2}(T_{k+1} + T_{k+3} - 1) \end{aligned}$$

The sequence can be generalized in the following manner: Let $t_1 = a$, $t_2 = b$, $t_3 = c$, and $t_n = t_{n-3} + t_{n-2} + t_{n-1}$ for $n \geq 4$ where a and b are nonnegative integers, c is a positive integer, and $a \leq b \leq c$. Challenge your students to find a formula for

$$\sum_{i=1}^{n} t_i.$$

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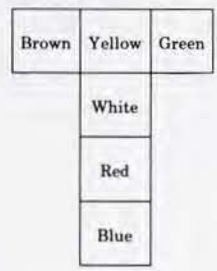
Corrections

The correct price of the set of slides entitled "What Do You See?" is $13.95. (See October 1983 review in "New Products," p. 37.)

The second "Problem of the Month" in September 1983 should have read, "A fly lands on the face of a die suspended in space. It then moves to an adjacent face. If the faces are labeled as shown in the figure below, what is the probability that the fly ends on the red face?" (Answer: 1/6 × 1 + 1/6 × 1/2 = 1/4)



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